

Remarks/Arguments

Applicant thanks the Examiner for careful consideration of the application.

Applicant notes, with appreciation, that claim 49 has been allowed.

Applicant amends claims 58 and 60.

I. Objections to specification:

Examiner on page 2 of the Office Communication has objected to the specification for failing to provide proper antecedent basis for the claimed subject matter found in claims 57-61. Applicant traverses Examiner's rejection.

In regards to claim 57, claim 57 discloses "means for generating a difference in thermal conductivity laterally within an essentially uniformly thick tantalum layer disposed over said substrate," which Applicant asserts is discussed in the specification at least at page 2, paragraph [0008] of Applicant's specification which states "the present invention also provides a method of forming a single sheet of tantalum (i.e. essentially uniformly thick tantalum layer) in which the structural phase of tantalum is laterally switched (i.e. "switching-phase-tantalum") between α -phase tantalum and β -phase tantalum at length scales in the nanometer range. Further, alpha or bcc-phase tantalum has a thermal conductivity an order of magnitude higher than β -phase tantalum, thus, the present invention provides a convenient method of generating surface temperature gradients by spatially controlling the phase of tantalum deposited over lateral length scales in the nanometer range." In addition, as Examiner has recognized and pointed out paragraph [0021] also provides support for the claim limitation presented in claim 57 by disclosing " the creation of various patterns or structures of alpha and beta phases of tantalum also provides a means of generating thermal and electrical gradients in the same tantalum layer, both within the film thickness (i.e. vertically as illustrated in Fig. 2c) and laterally on the surface temperature of the tantalum layer. By utilizing tantalum structures having sub-micrometer dimensions thermal and electrical gradients in this length scale may be generated." Further, Applicant asserts that various embodiments

disclosed within the specification provide further support since they can be used to generate a difference in thermal conductivity laterally within an essentially uniformly thick tantalum layer. Accordingly, Applicant asserts that the objection in regards to claim 57 has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the objection to the specification in regards to claim 57.

In regards to claim 58, claim 58 discloses "means for heating a fluid, said means for heating a fluid disposed between said tantalum layer and said substrate," which Applicant asserts is discussed in the specification at least at page 11, paragraph [0023] of Applicant's specification which states, in describing Fig. 3, "fluid ejector head 300 includes bcc-phase tantalum region 334 providing environmental, mechanical, and electrical protection to resistor 343. In providing environmental and mechanical protection bcc-phase tantalum region 334 provides protection from cavitation when resistor 343 is activated forming a vapor bubble in fluid chamber 352 that rapidly expands expelling a fluid drop through nozzle or orifice 362 and then rapidly collapses back on the surface of bcc-phase tantalum region 334." Accordingly, Applicant asserts that the objection in regards to claim 58 has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the objection to the specification in regards to claim 58.

In regards to claim 59, claim 59 discloses "means for electrically isolating said means for heating," which Applicant asserts is discussed in the specification at least at page 11, paragraph [0023] of Applicant's specification which states, "optional substrate dielectric layer 340 is a silicon oxide layer disposed on substrate 320. However, in alternate embodiments, other materials also may be utilized, such as metals or polymers, depending on the particular substrate material used and the particular application in which fluid ejector head 300 will be used. In this embodiment, the thickness of substrate dielectric layer is in the range from about 0.40 micrometers to about 0.75 micrometers. However, in alternate embodiments, the thickness of substrate dielectric layer 340 may be in the range from about 0.10 micrometers to about 2 micrometers," as well as page 13 paragraph [0025] which discloses the "embodiment shown in Fig. 3 utilizes two dielectric passivation formed over thermal resistor 343 and electrical

conductors 344, first dielectric layer 346 disposed on thermal resistor 343 and electrical conductors 344, and second dielectric layer 348 disposed on first dielectric layer 346. In this embodiment, first dielectric layer 346 is a silicon nitride (Si_3N_4) layer and second dielectric layer 348 is a silicon carbide (SiC_x) layer. However, in alternate embodiments, a single dielectric layer also may be utilized. In addition, a wide variety of dielectric materials may be utilized to form the first and second dielectric layers. For example, silicon oxide (SiO_2), boron nitride (BN_x), aluminum oxide (Al_2O_3), tantalum oxide (Ta_2O_5), and high temperature polymers such as polyimide also may be utilized. Fluid ejector head 300 also includes bcc-phase-tantalum forming seed structure 324 disposed on second dielectric layer 348 in the region over fluid ejector actuator 310." Accordingly, Applicant asserts that the objection in regards to claim 59 has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the objection to the specification in regards to claim 59.

In regards to claim 60, claim 60 discloses "means for generating a difference in electrical conductivity laterally within an essentially uniformly thick tantalum layer disposed over said substrate," which Applicant asserts is discussed in the specification at least at page 10, paragraph [0021] of Applicant's specification which Examiner has recognized and pointed out paragraph [0021] provides support for the claim limitation presented in claim 60 by disclosing "the creation of various patterns or structures of alpha and beta phases of tantalum also provides a means of generating thermal and electrical gradients in the same tantalum layer, both within the film thickness (i.e. vertically as illustrated in Fig. 2c) and laterally on the surface temperature of the tantalum layer. By utilizing tantalum structures having sub-micrometer dimensions thermal and electrical gradients in this length scale may be generated." Accordingly, Applicant asserts that the objection in regards to claim 60 has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the objection to the specification in regards to claim 60.

In regards to claim 61, claim 61 discloses "wherein said essentially uniformly thick tantalum layer has an essentially uniform composition," Applicant asserts is discussed in the specification at least at page 1, paragraph [0002] of Applicant's

specification which states it "is well known that tantalum films may be produced in two different crystallographic phases, body-centered-cubic (bcc), commonly referred to as alpha tantalum (α -phase), and tetragonal, commonly referred to as beta tantalum (β -phase). Typically, the deposition of a high quality bcc tantalum film requires high quality vacuum systems having pressures less than 10^{-7} Torr, high deposition rates of greater than 1 nanometer per second, and elevated substrate temperatures of greater than 300 °C. On the other hand, β -phase tantalum generally is formed at higher pressures, lower deposition rates, and lower substrate temperatures. The ability to form both phases of tantalum under a common set of conditions will open up a wide variety of applications that are currently either impractical or are not cost effective." Accordingly, Applicant asserts that the objection in regards to claim 61 has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the objection to the specification in regards to claim 61.

II. Rejections under 35 U.S.C. §112

Examiner on page 2 of the Office Communication has rejected claims 57-61 under 35 U.S.C. §112, first paragraph. Applicant respectfully traverses Examiner's rejection. Applicant asserts the response given above in regards to Examiner's objection to the specification covering claims 57-61 overcomes Examiner's rejection that the claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the art that the inventor had possession of the claimed invention. In regards to claim 57 Applicant has pointed where in the specification the claimed subject matter is disclosed. Applicant has no idea what Examiner means by the phrase "it is unclear whether the entirety of the breadth of claim 57 is supported by paragraph 21." Applicant traverses Examiner's statement. Applicant argues without a more reasoned explanation, based on sound technical and scientific reasoning given by Examiner as to why Examiner believes paragraph 21 does not support the entirety of the breadth of claim 57 Examiner has failed to establish a *prima facie* case under 35 U.S.C. §112, first paragraph. Further, in regards to claims 58-61 Examiner's statement "it is unclear how the other claims are supported," without any explanation clearly fails to establish a *prima facie* case under 35 U.S.C. §112, first paragraph. The use of a mere conclusory statement as such does not provide Applicant

any reasonable means of responding except to guess as to Examiner's reasoning or interpretation. Applicant respectfully requests, in order to clarify the issues to be addressed in appeal, Examiner provide in Examiner's Advisory action some explanation as to what Examiner sees is the entirety of the breadth of claim 57 that is not supported by Applicant's specification, i.e. some examples in particular and, provide some reasoned explanation, based on sound technical and scientific reasoning for the rejection of claims 58-61. Accordingly, Applicant asserts that the rejection in regards to claims 57-61 has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection under 35 U.S.C. §112, first paragraph in regards to claims 57-61.

Examiner on page 3 of the Office Communication has rejected claims 57-61 under 35 U.S.C. §112, second paragraph as being indefinite. Applicant asserts that the response given above in regards to Examiner's rejection based on 35 U.S.C. §112 first paragraph and Examiner's objection to the specification covering claims 57-61 overcomes Examiner's rejection based on 35 U.S.C. §112, second paragraph as being indefinite. Applicant asserts that Examiner has failed to establish a *prima facie* case of indefiniteness for claims 57-61. In particular, even supposing that Examiner has established a *prima facie* case of indefiniteness, Applicant asserts the response above for claims 57 and 60-61 overcomes Examiner's rejection.

Applicant notes that Examiner has miss numbered the claims and when arguing claim 59 is actually arguing claim 58. In regards to claim 58, although Applicant believes claim 58 as originally written was clear on its face, Applicant has amended claim 58 to further clarify "means for heating."

In regards to claim 59 Examiner has provided no argument, therefore Applicant assumes claim 59 is allowable.

In regards to claim 60, although Applicant believes claim 60 as originally written was clear on its face, Applicant has amended claim 60 to clarify the relationship between the means plus function limitation of claim 57 and the added means plus function limitation of claim 60.

In regards to claim 61 Applicant can only ask what about a uniform composition is unclear. Applicant respectfully disagrees with Examiner that a uniform composition is unclear because the tantalum layer includes alpha and beta Ta in the layer. Applicant has no idea why Examiner is making such a statement and provides no reasoned explanation, based on sound technical and scientific reasoning why these two elements/limitations when claimed together are unclear. Applicant respectfully requests, in order to clarify the issues to be addressed in appeal, Examiner provide in Examiner's Advisory action some explanation as to what Examiner sees is unclear in regards to the limitation "a uniform composition," found in claim 61.

Accordingly, Applicant asserts that the rejection in regards to claims 57-61 being indefinite has been overcome. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection under 35 U.S.C. §112, second paragraph as being indefinite in regards to claims 57-61.

III. Rejections under 35 U.S.C. §102(e):

Examiner, on page 2 of the Office Communication has rejected claims 1, 3-10, 12, 15-17, 19, 29, 31-32, 34, 37, 44, 50, 57, and 60-61 under 35 U.S.C. §102(e) as being anticipated by Seet et al. (U.S. Patent Publication No. 2004/0131878, "Seet") This rejection is respectfully traversed with regard to claims 1, 3-10, 12, 15-17, 19, 29, 31-32, 34, 37, 44, 50, 57, and 60-61 because all of the elements of the claimed invention are not present in the cited references.

Applicant continues to traverse Examiner's rejection of independent claim 1. Examiner in response to Applicant's argument states "Seet teaches [a] mixed phase Ta layer, wherein the first layer is the copper underlayer and the second layer is the copper overlayer." Applicant notes claim 1 claims "creating a tantalum layer disposed on . . . a first layer and on . . . a second layer. Applicant argues the plain ordinary meaning of "on" is to indicate position over and in contact with that which supports from beneath. Applicant notes as clearly shown in Fig. 2c metal layer 34 is formed over the Ta barrier layer 24. Thus, Seet discloses a mixed phase Ta layer disposed on the copper layer 13

and a metal layer 34 disposed over or on the mixed phase Ta layer, e.g. the second layer, metal layer 34, is over or above the Ta layer in contradiction to the plain ordinary meaning of "on" as used in Applicant's claim 1. In addition, Applicant notes that Examiner is clearly using the mixed phase Ta layer to assert against Applicant's claim language of "wherein said tantalum layer is a substantially bcc-phase tantalum region on said first layer region and said tantalum layer is a non-bcc-phase tantalum region on said second layer region." Since, Seet, as best applicant can determine, in disclosing the mixed phase tantalum film is silent on the distribution of the phases in the films Applicant assumes that the mixed phase film is a random mixed phase. Thus, Seet discloses a Ta layer having an equal likelihood of phases at both the bottom and top copper surfaces. Without a more reasoned explanation Applicant is left to guess why Examiner is arguing the first layer is the copper underlayer and the second layer is the copper overlayer. Applicant asks why not the first layer is the copper overlayer and the second layer is the copper underlayer since Examiner must admit there is an equal likelihood of both phases at both interfaces. Applicant is unaware of any distinguishing feature disclosed in Seet that in the case of a mixed phase Ta layer there is any crystallographic structural difference of the Ta layer at either the top or bottom copper surface. Applicant is left to guess as to why Examiner believes such a disclosure discloses a tantalum layer having a substantially bcc-phase tantalum region on a first layer region of a first layer and a non-bcc tantalum region on a second layer region of a second layer. This is especially true since Seet discloses that the mixed phase Ta layer having between 35 and 50 wt % alpha phase Ta and between 50 to 65 wt % beta phase Ta. Applicant can only ask is Examiner clearly asserting that 50 weight percent of alpha Ta rises to the level of anticipating a claim limitation stating "a substantially bcc-phase tantalum region."

In addition, independent claim 50 discloses "wherein said tantalum layer forms a substantially bcc-phase tantalum region where said tantalum layer is in contact with said bcc-phase-tantalum forming seed region, and wherein said tantalum layer forms a non-bcc-phase tantalum region where said tantalum layer is not in contact with said bcc-phase tantalum forming seed region," which is also not disclosed by Seet for the same reasons as discussed above for independent claim 1.

Further, in regards to independent claim 57, claim 57 discloses "a substrate; and means for generating a difference in thermal conductivity laterally within an essentially uniformly thick tantalum layer disposed over said substrate." Applicant traverses Examiner statement found on page 4 of the Office Communication stating, Seet also teaches the that the tantalum layer is comprised of alpha and beta Ta, which applicant has explained gives rise to differences in thermal conductivity and electrical conductivity." Applicant argues that the arguments given above for claim 1 and 50 overcome Examiner's rejection of claims 57 and 60. In addition, Applicant points out that only within an isolated grain can Examiner's statement even possibly be asserted. Over any distance larger than a single grain the thermal and electrical conductivity will be averaged over the number of grains and thus will not result in any difference in thermal and electrical conductivity because of the random distribution unlike Applicant's claimed invention. Since as argued above the mixed phase Ta layer disclosed in Seet appears to be a random mixture then the thermal and electrical conductivities will likewise have an average value based on the number of grains of each phase present. Thus, Applicant asserts Seet does not anticipate claims 57 and 60.

Applicant continues to assert Seet does not anticipate the present invention as set forth in independent claims 1, 50, and 57. In addition, dependent claims 3-10, 12, 15-17, 19, 29, 31-32, 34, 37, 44 are dependent upon independent claim 1 and dependent claims and 60-61 are dependent upon independent claim 57 and are therefore believed to be allowable, at least for this reason alone, as dependent upon a believed allowable claim. Therefore, Applicant respectfully requests that the Examiner withdraw the rejection of claims , 3-10, 12, 15-17, 19, 29, 31-32, 34, 37, 44, 50, 57 and 60-61 based on Seet under 35 U.S.C. §102(e).

In addition, in regards to dependent claims Applicant continues to assert the arguments presented in the previous response.

In particular in regards to dependent claim 12, Examiner states layer 10 in Fig. 2C may be sacrificed. Applicant notes since Examiner in responding to Applicant's

response stating that a sacrificial layer is not found in Seet Examiner states layer 10 may be sacrificed and does not state that Seet discloses the substrate as a sacrificial layer. To be a proper anticipatory prior art reference Seet must either expressly or inherently disclose the subject matter. Since Examiner has not cited where in Seet such a disclosure is made Examiner must be asserting Seet inherently makes such a disclosure. Applicant further argues that if the reference inherently discloses the claimed subject matter then the prior art must make clear that a sacrificial layer is necessarily present and it must not require any modification of the prior art reference. Applicant asserts in this case neither requirement is met. Therefore, based on this reason alone Applicant asserts dependent claim 12 is allowable.

IV. Allowable subject matter:

Applicant acknowledges that claim 49 has been allowed. In addition, Applicant acknowledges that Examiner has objected to claims 2, 11, 13-14, 18, 20-28, 30, 33, 35-36, 38-43, 45-48, and 51-53 as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Since Applicant believes that independent claims 1, 50, and 57 are each allowable over Seet Applicant has chosen at this time not to amend the objected to claims.

Therefore, in view of the foregoing Amendment and Remarks, Applicant believes the present application to be in a condition suitable for allowance. Examiner is respectfully urged to withdraw the rejections, reconsider the present Application in light of the foregoing Amendment, and pass the amended Application to allowance.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is respectfully requested to call Applicant's representative at (541) 715-1694 to discuss the steps necessary for placing the application in condition for allowance.

Favorable action by the Examiner is solicited.

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